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EPIDEMIOLOGICAL PROFILE OF LEPTOSPIROSIS IN TAMIL NADU, 2021-2024: AN ANALYSIS OF IDSP-IHIP PROGRAMME DATA

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Abstract

INTRODUCTION : Leptospirosis is a zoonotic disease of public health importance driven by climate and ecological factors. It is noted as a re-emerging disease by WHO, and the number of cases are increasing steadily. The present study was undertaken to understand the epidemiological profile and trend of leptospirosis, analyze the trends of leptospirosis cases between 2021 & 2024, and forecast the disease.
METHODOLOGY : The data of confirmed leptospirosis cases in Tamil Nadu were retrieved from the IDSP- IHIP portal and entered in MS- Excel. Statistical analysis was done using SPSS version 20.0. Descriptive statistics was used. For analysing the trend and to forecast the same, the time series analysis method was used.
RESULTS : The positivity rate of leptospirosis was 9.7% (95% CI: 9.5 to 9.9). The mean age of the leptospirosis cases was 35 years. Of the 7080 cases, females were 50.18%. The majority of cases were from Chennai (35.4%). The trend of leptospirosis depicts that the number of cases starts to increase June to December. This typically corresponds with the rainy season of Tamil Nadu. The predicted number of cases for January 2021 to March 2024 made by the model matched with original number reported in the IDSP- IHIP portal. On forecasting, the model showed a steady increase in the number of cases each year, still following the seasonal trend.
CONCLUSION : Leptospirosis shows a seasonal trend with more cases from June to December, and it correlates with the rainy and flooding season of the region.
KEYWORDS : Leptospirosis, zoonotic disease, trends, time series analysis, forecast

INTRODUCTION

Leptospirosis is a zoonotic disease with epidemic potential. It is caused by the bacterium Leptospira. The disease is endemic in countries with humid subtropical, tropical and temperate climates.[1] The prevalence of leptospirosis, as per WHO, ranges from 0.1 to 1 per 100,000 per year in temperate climates. It goes up to 10 or more per 100,000 annually in the humid tropics. During outbreaks and in high-risk groups, disease incidence may reach over 100 per 100,000.[2] India is known for outbreaks of leptospirosis and has been documented in India since 1931. The disease is endemic in Kerala, Tamil Nadu, Karnataka, Gujarat, Maharashtra and Andaman and Nicobar islands. It has also been reported from Andhra Pradesh, Goa, Orissa, West Bengal, Uttar Pradesh, Delhi, Puducherry, Dadar & Nagar Havelli, Daman & Diu.[3,4,5] In Tamil Nadu, leptospirosis cases have been reported from Chennai since 1980's.[3] All the districts in Tamil Nadu except Udhagamandalam and Thoothukudi are endemic for Leptospirosis.[6]

Leptospirosis has been reported as significant emerging and re-emerging disease by the World Health Organization (WHO). It widely spreads among humans and animals due to the rapid ecological changes such as rapid urbanization, poor sanitation, poor or improper waste management, poor surveillance program and control plan, and negligence of the disease.[4,7] They remain neglected even in the most endemic countries because of the lack of awareness, clinical suspicion, and absence of suitable diagnostic tools - effectively putting them in the category of Neglected Zoonotic Diseases (NZDs). Moreover, significant under-reporting and under-diagnosis of leptospirosis cases has been noticed.[8]

Human infections are rampant in tropical regions with high rainfall, where the human population gets exposed to water contaminated with the infected urine of the animals. Rodents are considered the major reservoir of infection. Leptospira are excreted in the urine of the infected animals. Hence, this illness commonly occurs during the monsoon months. The infection is usually transmitted when they pass through stagnant rainwater contaminated by the infected urine of animals. They can also enter the host through the abrasions of the skin on the feet or through intact mucous

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membranes of the eye, throat, and gut.[3,9]

The clinical spectrum of leptospirosis ranges widely from mild anicteric presentation to severe leptospirosis with multiple organ involvement. Fever, jaundice, vomiting, diarrhoea, intravascular disseminated coagulation, renal and hepatic insufficiency followed by renal and hepatic failure, myocarditis with cardiac arrhythmias, pulmonary hemorrhage with respiratory failure, and death are possible symptoms of leptospirosis. Because of its wide presentation, all cases of fever with myalgia and conjunctival suffusion in endemic areas should be suspected of leptospirosis.[3,4,9]

Leptospirosis follows a seasonal pattern in most countries. Meteorological factors like temperature, humidity, and rainfall play a vital role in its etiology.[2,10] An understanding of the seasonal trend of leptospirosis would help in knowing the disease burden in advance. This in turn, would help the public health administrators take appropriate actions to control and prevent future outbreaks. In this context, the present study was undertaken to describe the epidemiological profile, analyze the trends of leptospirosis cases between 2021 and 2024, and forecast the disease for the next three years.

METHODOLOGY

This retrospective study was done using the surveillance data of leptospirosis cases. The data was retrieved from the IDSP – IHIP (Integrated Disease Surveillance Programme- Integrated Health Information Platform) portal of Directorate of Public Health and Preventive Medicine, Tamil Nadu between April 2021 and March 2024. Prior permission was obtained from the Director of Public Health and Preventive Medicine (DPH & PM), Tamil Nadu, for the use of secondary surveillance data.

IDSP was started in the year 2004 to strengthen the disease surveillance in the country and also to improve the reporting of cases. Based on the recommendation of the 2015 Joint Monitoring Mission report to review and redesign the IDSP surveillance system, the IDSP-IHIP portal was launched, and it became functional on April 5th, 2021. Following that, the cases are reported in the IDSP- IHIP portal on a real time daily basis from the Government and private health institutions.[11]

Operational definitions:[12,13]

Probable case of leptospirosis (P form): A person having acute febrile illness with headache, myalgia and prostration associated with a history of exposure to infected animals or an environment contaminated with animal urine with one or more of the following: Calf muscle tenderness (or) Conjunctival suffusion (or) Anuria (or) oliguria (and/or) proteinuria (or) Jaundice (or) Haemorrhagic manifestations (or) Meningeal irritation (or) Nausea, Vomiting, Abdominal pain, Diarrhoea (and)

Laboratory confirmed case of leptospirosis (L form): A case compatible with the clinical description of leptospirosis with at least one of the following: High titre of IgM antibodies in ELISA (evaluated with locally determined cut-off) for single clinical sample (or) Four-fold or greater rise or persistent titre (in case of antibiotic given) in the MAT (total antibodies) between acute and convalescent-phase serum specimens run parallel (or) Seroconversion on ELISA in paired serology (demonstrating conversion of IgM to IgG antibodies).

[Isolation and Validated PCR can be done in patients who have not received antibiotic and in early stage of diseases (preferably less than 7 days].

Positivity rate: Number of positive results/ Total number of tests done x 100.

We got the line-listing of all laboratory-confirmed leptospirosis cases reported during the study period. The line list included the epidemiological and laboratory profiles of all the cases.

Statistical analysis:

The month- and year-wise data of leptospirosis cases was entered in MS Excel, and statistical analysis was performed using IBM SPSS Statistics, version 20. Data on a categorical scale are presented in numbers and percentages, and those on a continuous scale are presented in Mean ± SD.

For analysing the trend and to forecast the same, time series analysis with an expert modeller method was used. Trend analysis was done from January 2021 to March 2024 and forecasting was attempted from April 2024 to December 2027. The correctness of the model was verified using Ljung-Box statistics.

RESULTS :

Table 1: Age-wise distribution of leptospirosis cases in Tamil Nadu between 2021and 2024

Variable	Frequency (N= 7080)	Percentage (%)
Age category		
< 5 years	175	2.5
6 to 9 years	277	3.9
10 – 19 years	1147	16.2
20 to 40 years	2845	40.2
40 to 60 years	1831	25.9
>60 years	805	11.4
Gender		
Male	3525	49.78
Female	3553	50.18
Transgender	2	0.03

During the study period from April 2021 to March 2024, 7080 confirmed cases of leptospirosis were reported in the IDSP-IHIP portal. The Mean (± SD) age of the study cases was 35 years (± 18.7).

Table 1 represents the age and distribution of the leptospirosis cases. Majority of the cases belonged to the age group of 20 to 40 years (40.2%) followed by the age group of 40 to 60 years (25.9%).

Among the 7080 leptospirosis cases reported, the proportion of females (50.18%) was higher than that of males (49.78%), and the difference is statistically significant with p<0.05 by univariate analysis.

During the study period, 73329 samples suspected of leptospirosis were tested, and 7080 were confirmed of the disease.

Table 2: Positivity rate of leptospirosis between April 2021 and March 2024

Gender	Total samples tested	Samples positive	Positivity rate	95% CI
Male	34821	3525	10.1	9.8 to 10.4
Female	38485	3553	9.2	8.5 to 9.5
Transgender	23	2	9.1	1.1 to 29.1
Total	73329	7080	9.7	9.5 to 9.9

Table 2 shows the positivity rate of leptospirosis for males, females and transgender. The positivity rate of leptospirosis was estimated to be 9.7% (95% CI: 9.5 to 9.9).

The majority of the samples were confirmed by IgM ELISA (70.8%) followed by MAT serology (26.6%), rapid IgM test (2.3%) and culture (0.2%). Most reported cases (63.6%) required hospitalization; and others (36.4%) were treated in the 31 outpatient department.

The district-wise distribution of leptospirosis cases in Tamil Nadu shows that Chennai (35.4%) has the majority of cases followed by Thiruvallur (9.6%), Thiruvannamalai (5.5%), Thiruvarur (4.3%) and Kanniyakumari (3.9%). 1.9% of cases were migrants from Kerala, Andhra Pradesh, Karnataka, Maharashtra, West Bengal, Orissa, Uttar Pradesh, Nepal, Manipur, Jharkhand, etc. (Figure 1)

Total number of cases reported from January 2021 to March 2024 was 7293 (Cases from January 2021 to March 2021 was taken from the old version of IDSP).

The highest number of cases (2799) was reported in the year 2023 followed by 2022 (2643). On comparing the monthly data of leptospirosis cases from 2021 to 2023, it clearly shows that the number of cases starts to increase from June, and steadily increases till December and then gradually decreases. This trend is consistent every year. (Figure 2).
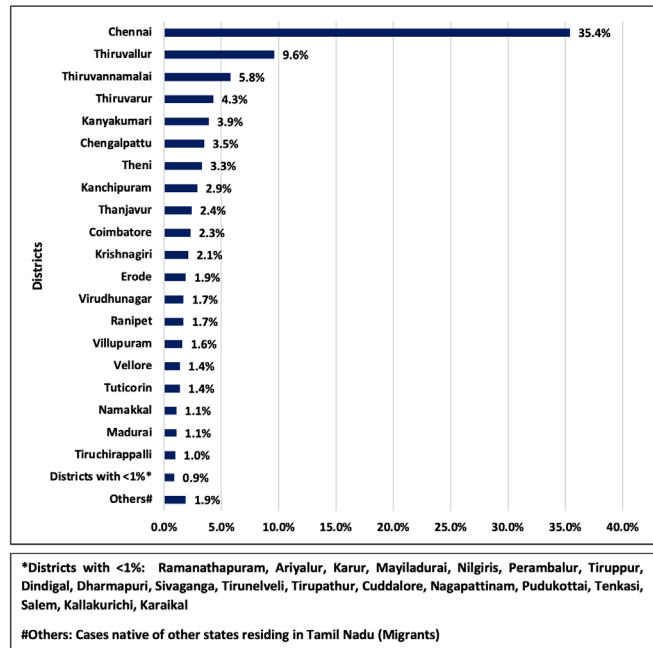

*Districts with <1%: Ramanathapuram, Ariyalur, Karur, Mayiladurai, Nilgiris, Perambalur, Tiruppur, Dindigal, Dharmapuri, Sivaganga, Tirunelveli, Tirupathur, Cuddalore, Nagapattinam, Pudukottai, Tenkasi, Salem, Kallakurichi, Karaikal

#Others: Cases native of other states residing in Tamil Nadu (Migrants)

Figure 1: District-wise distribution of leptospirosis cases in Tamil Nadu between 2021 and 2024 (N=7080)
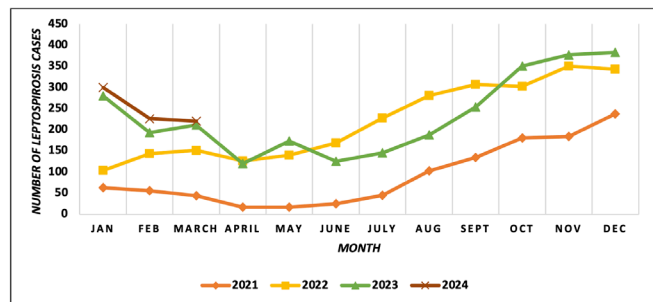

Figure 2: Trends of leptospirosis in Tamil Nadu between 2021 and 2024

The time series chart was created by SPSS using expert Modeller method with number of cases of leptospirosis month and year-wise. The model showed a showed seasonal periodic trend. The expert modeller in SPSS suggested a Winter's Additive model as the best fitting model for this time series data. Ljung- Box statistics test indicated that the model was correctly specified for the data [p = 0.187 (p>0.05)]. The expert modeller did not find any outliers in the model.

As per the figure 3, it was observed that the predicted number of cases for January 2021 to March 2024 made by the model matched with original number reported in Tamil Nadu as per IDSP- IHIP data. With this model fit, the number of cases that can be expected for the next three years was forecasted. The model showed a steady increase in the number of cases each year (2024 – 3474 cases; 2025 – 3699 cases, 2026 – 4986 cases, 2027 – 5785 cases) yet

following the seasonal trend. The graph shows the observed cases, forecasted cases with LCL (Lower Confidence Limit) and UCL (Upper Confidence Limit).
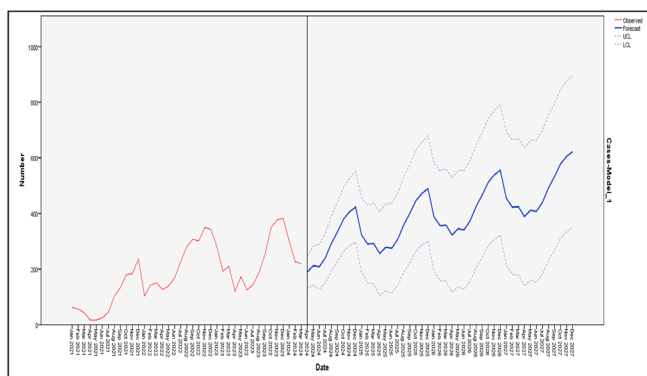

Figure 3 : Time series analysis chart from 2021 to 2023 and Forecast of leptospirosis cases from 2024 to 2027

DISCUSSION

Leptospirosis is a neglected zoonotic disease. It is reported to be an emerging and re-emerging disease due to rapid ecological changes. The change in the distribution and incidence of leptospirosis has occurred proportionately to the alterations in the eco-system; causing major epidemics in different regions.[4] To improve the surveillance of the disease, leptospirosis cases are reported in the IDSP – IHIP portal on daily real-time basis in India. Surveillance data was retrieved from the IDSP-IHIP portal to understand the trends of leptospirosis in the state of Tamil Nadu.

Out of the 73329 samples tested for leptospirosis, 7080 were confirmed of the disease. The majority of cases belonged to the age group of 20 to 60 years (66.1%). The mean age of the study cases was 35 years. This is in line with the studies done by Shukla S et al.[5] in Uttarpradesh, Arumugam G et al.14 in Chennai, Vidhya VR et al.1[15] in Kanniyakumari, Kalaivani V et al.16 in Thoothukudi, Sethi S et al.[17] in Northern India and Muthsethupathi MA et al.[18] in Chennai. These studies state that though all ages are susceptible, majority of leptospirosis cases belong to the age group between 20 and 40 years which represent the occupationally active group; and the males are more affected than the females. However, in this study, the proportion of females (50.18%) are higher than that of males (49.78%). This may be because, the increase in women getting involved in occupations (agriculture, animal husbandry, fisheries), involving outdoor work and recreation. Another reason may be, among the 73329 samples tested, the proportion of the females (38,485) tested are higher than the males (34,821).

In this study, the positivity rate of leptospirosis was estimated to be 9.7% (95% CI: 9.5 to 9.9). The estimation of positivity rate for leptospirosis varies widely in different regions of the country. A meta-analysis showed, the positivity rate was found to be 9.47% between 2005 and 2023. Similarly, the positivity rate of leptospirosis over 10 years from 2011 to 2021 in Chengalpattu district, Tamil Nadu was found to be of 9.14%.[9] A study along coastal Thoothukudi had 10% positivity rate.16 A multi-centric study by ICMR task force estimated the positivity rate of leptospirosis in India to be 12.7% ranging between 3.27 to 28.2%.[19] In Tamil Nadu, Chennai showed a greater positivity rate ranging from 17.8% to 40.5%.[3,14]

In this study, the top five districts that showed higher prevalence in the study period are Chennai (35.4%), Thiruvallur (9.6%), Thiruvannamalai (5.5%), Thiruvarur (4.3%) and Kanniyakumari (3.9%). Chennai always has a higher prevalence than other parts of the state. Leptospirosis occurs in Chennai throughout the year.[14] Leptospirosis is rampant in areas with inadequate sanitation and hygiene associated with copious rainfall and flooding. Moreover, cities like Chennai have more slums that create an ideal environment for rodents, which are the primary carriers of the Leptospira. Dense population and insanitation favour the spread of the disease.[20-22]

In addition to this, coastal regions and agricultural districts of rice farming are noted to have a higher incidence of leptospirosis. Coastal regions experience hot humid climate that favours the growth of bacteria. Furthermore, the existence of water bodies that become infected with the urine of contaminated animals favours the disease spread. Moreover, fishing practices in these districts also play a significant role. Fishermen are probably exposed to the infected water and soil.[20-22]

In this study, the trend of leptospirosis clearly shows that the number of cases starts to increase from June. It steadily increases till December and then gradually decreases from January. This typically corresponds with the rainy season of Tamil Nadu. Tamil Nadu has three distinct periods of rainfall - southwest monsoon from June to September, rainfall from the tropical cyclones from October–November, and the North-East monsoon from October–December. Mid-June to December is the monsoon months in Tamil Nadu. January remains cooler, with comparatively dry days till April. Due to the cool dry weather, the growth of leptospirosis is subdued.

This similar pattern of increasing cases post-monsoon is also noted in Kerala, Karnataka, Maharashtra and other endemic areas.[3,20] Rice is the principal crop of cultivation, depends primarily on rainfall, and there is a

close interaction of soil, animals, and humans during this period. The stagnant water in the rice fields provides an ideal environment for increasing the probability of contamination. The heavy rainfall can also result in flooding and landslides, displacing rats from their habitats and moving them to human settlements, escalating the risk of infection.[2,3,8,9,10,17,20-23] On forecasting the number of cases that would be expected for the next three years using the expert modeller method, the model showed a steady increase in the number of cases each year (2024 – 3474 cases; 2025 – 3699 cases, 2026 – 4986 cases, 2027 – 5785 cases) yet following the seasonal trend as discussed above.

This study is not without limitations. Leptospirosis is a zoonotic disease greatly influenced by ecological factors like rainfall, temperature and humidity. However, these factors were not taken into consideration while forecasting the number of cases with time series analysis. This paves the scope for further research.

Leptospirosis is an emerging zoonotic disease influenced by climate and environment. This study shows a seasonal pattern of leptospirosis that is strongly interdependent with the monsoon. A significant increase in the incidence of leptospirosis is expected in the following years. Predicting the burden of the disease in advance will help public health administrators to manage the disease occurrence efficiently.

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